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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

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June 1970

U.S. Training and
Employment Service
Technical Report
S-76 R

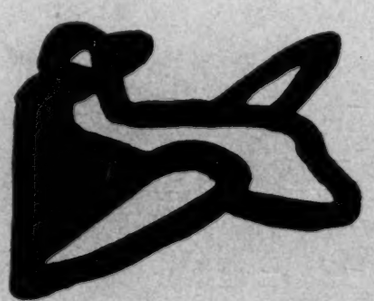
Development of USTES

APTITUDE TEST
BATTERY FOR

SELECTED AIRCRAFT ASSEMBLY OCCUPATIONS

(aircraft mfg.)

U.S. DEPARTMENT OF LABOR
Manpower Administration



TM 001 273

Technical Report on Development of USTES Aptitude Test Battery
For . . . .

Aircraft Mechanic, Plumbing And Hydraulics 862.381
Aircraft Mechanic, Rigging And Controls 801.381
Assembler, Aircraft Power Plant 621.381
Assembler, Aircraft, Structures and Surfaces 806.381

(Developed in Cooperation with the
Texas State Employment Service)

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U. S. Department of Labor
Manpower Administration

June 1970

FOREWORD

The United States Training and Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination, predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

GATB Study #836

DEVELOPMENT OF USTES APTITUDE TEST BATTERY

For

Aircraft Mechanic, Plumbing and Hydraulics 862.381-010
Aircraft Mechanic, Rigging and Controls 801.381-010
Assembler, Aircraft Power Plant 621.381-010
Assembler, Aircraft, Structures and Surfaces 806.381-010

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This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupations of Aircraft Mechanic, Plumbing and Hydraulics 862.381-010, Aircraft Mechanic, Rigging and Controls 801.381-010, Assembler, Aircraft Power Plant 621.381-010 and Assembler, Aircraft, Structures and Surfaces 806.381-010. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
S - Spatial Aptitude	70
P - Form Perception	70
F - Finger Dexterity	80
M - Manual Dexterity	90

RESEARCH SUMMARY

Sample:

Fifty-two male workers employed in the occupations of Aircraft Mechanic, Plumbing and Hydraulics, Aircraft Mechanic, Rigging and Controls, Assembler, Aircraft Power Plant and Assembler, Aircraft, Structures and Surfaces in Texas. This study was conducted prior to the requirement of providing minority group information. Therefore, minority group status is unknown

Criterion:

Supervisory ratings.

Design:

Concurrent (test and criterion data were collected at approximately the same time).

Minimum aptitude requirements were determined on the basis of a job analysis and statistical analyses of aptitude mean scores, aptitude-criterion correlations and selective efficiencies.

Concurrent Validity:

Phi coefficient = .63 ($P/2 < .0005$)

Effectiveness of Norms:

Only 65% of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 91% would have been good workers. Thirty-five percent of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the above norms, only 9% would have been poor workers. The effectiveness of the norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	65%	91%
Poor Workers	35%	9%

SAMPLE DESCRIPTION

Size:

N = 52

Occupational Status:

Employed Workers.

Work Setting:

Workers were employed by the Consolidated Vultee Aircraft Corporation, Fort Worth, Texas.

Employer Selection Requirements:

Education: None required.
Previous Experience: None required.
Tests: None used.

Principal Activities:

The job duties for each worker are comparable to those shown in the job description in the Appendix.

Minimum Experience:

All workers in the final sample had at least six months job experience.

TABLE 2

Means, Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education, Experience

	Mean	SD	Range	r
Age (years)	38.9	9.4	23-62	-.39**
Education (years)	9.9	2.2	6-15	.35*
Experience (months)	84.2	41.0	6-144	.11

**Significant at the .01 level
*Significant at the .05 level

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1001, were administered in April 1954. B-1001 scores were converted to equivalent B-1002 scores.

CRITERION

The criterion consisted of pooled supervisory ratings obtained at group meetings of people in the Personnel, Training, and Production Departments who were familiar with all of the workers in the sample. Each worker was rated as good, average, or poor. There were 15 workers rated good, 19 workers rated average, and 18 workers rated poor. For statistical analysis, these broad category ratings were converted to quantitative scores. The good, average, and poor categories were assigned scores of 62, 51, and 39, respectively.

Criterion Dichotomy:

The criterion distribution was dichotomized into low and high groups by placing 35% of the sample in the low group to correspond with the percentage of workers considered unsatisfactory or marginal. Workers in the high criterion group were designated as "good workers" and those in the low group as "poor workers." The criterion critical score is 51.

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were selected for tryout in the norms on the basis of a qualitative analysis of job duties involved and a statistical analysis of test and criterion data. Tables 3, 4 and 5 show the results of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis
(Based on the job analysis, the aptitudes indicated appear to be important to the work performance)

Aptitudes	Rationale
G - General Learning Ability	Required to understand blueprints, operations sheets, and engineering orders and to determine sequences of operations and methods of installation.
S - Spatial Aptitude	Required to visualize installations from blueprints, sketches and operations sheets.
P - Form Perception	Required to recognize size and types of bolts and rivets and also to aid in ascertaining adjustments which may have to be made after a functional check of installations or systems.
F - Finger Dexterity	Required in all phases of handling the equipment skillfully and accurately.
M - Manual Dexterity	Required in joining and installing parts, assemblies and systems on airplanes under construction.

TABLE 4

Means, Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB

N = 52

	Mean	SD	Range	r
G - General Learning Ability	89.4	16.3	55-131	.40**
V - Verbal Aptitude	87.2	15.8	63-122	.16
N - Numerical Aptitude	87.5	18.3	40-124	.36**
S - Spatial Aptitude	93.7	18.4	63-143	.41**
P - Form Perception	87.3	21.2	38-133	.50**
Q - Clerical Perception	80.8	13.5	59-119	.56**
K - Motor Coordination	79.2	18.5	37-111	.34*
F - Finger Dexterity	90.8	21.2	43-134	.52**
M - Manual Dexterity	101.3	22.4	32-152	.55**

**Significant at the .01 level
*Significant at the .05 level

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data: Important	X			X	X			X	X
Irrelevant									
Relatively High Mean				X				X	X
Relatively Low Standard Deviation						X			
Significant Correlation with Criterion	X		X	X	X	X	X	X	X
Aptitudes to be Considered for Trial Norms	G		N	S	P	Q	K	F	M

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of the degree to which trial norms consisting of various combinations of aptitudes G, N, S, P, Q, K, F, and M at trial cutting scores were able to differentiate between the 65% of the sample considered to be good workers and the 35% of the sample considered to be poor workers. Trial cutting scores at five-point intervals approximately one standard deviation below the mean are tried because this will eliminate about one-third of the sample with three-aptitude norms. For four-aptitude trial norms, cutting scores of slightly less than one standard deviation below the mean will eliminate about one-third of the sample; for two aptitude trial norms, minimum cutting scores of slightly more than one standard deviation below the mean will eliminate about one-third of the sample. The phi coefficient was used as a basis for comparing trial norms. Norms of S-70, P-70, F-80 and M-90 provided optimum differentiation for the occupations of Aircraft Mechanic, Plumbing and Hydraulics 862.381-010, Aircraft Mechanic, Rigging and Controls 801.381-010, Assembler, Aircraft Power Plant 621.381-010, and Assembler, Aircraft, Structures and Surfaces 806.381-010. The validity of these norms is shown in Table 6 and is indicated by a phi coefficient of .63 (statistically significant at the .0005 level).

TABLE 6

Concurrent Validity of Test Norms
S-70, P-70, F-80, and M-90

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	5	29	34
Poor Workers	15	3	18
Total	20	32	52

Phi coefficient = .63 Chi square (X^2_y) = 20.6
Significance level = P/2 $<$ .0005

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study met the requirements for incorporating the occupations studied into OAP-48 which is shown in the 1970 edition of the Manual for the General Aptitude Test Battery. A phi coefficient of .48 is obtained with the OAP-48 norms of S-75, P-75 and M-75.

June 1970

FACT SHEET

S-76R

Job Title

Aircraft Mechanic, Plumbing and Hydraulics (aircraft mfg.) 862.381-010
Aircraft Mechanic, Rigging and Controls (aircraft mfg.) 801.381-018
Assembler, Aircraft Power Plant (aircraft mfg.) 621.381-010
Assembler, Aircraft, Structures And Surfaces (aircraft mfg.) 806.381-010

Job Summary

Performs any of the following operations in joining and installing parts, assemblies, and systems on airplanes under construction: joints together preformed airplane structural parts and minor assemblies to form fuselages, tails, wings, and other major assemblies; puts together and installs partially assembled aircraft engines in predetermined location; installs gasoline and oil lines, instrument tubing, electrical conduit, hydraulic and pressure systems and other tubing and piping systems; and fits and installs control surfaces such as rudder, elevator, ailerons, and flaps, and connects cabin controls to them by means of cables routed through wings and fuselage.

Work Performed

Joins together preformed airplane structural parts and minor assemblies to form fuselages, tails, wings, and other major airplane assemblies: Locates, measures and marks hole patterns, trim lines and reference points by using templates, tooling aids or sample parts. Uses blueprints, sketches and operations sheets to determine relationship and location of parts, mating points, identification of parts, rivet patterns, size and type of bolts and rivets and primary dimensions of structural components to be joined together. Fits together in a jig adjoining structural members and drills holes in parts for subsequent riveting, using an electric power drill. Marks location of rivet holes in undrilled parts either by positioning a template over the part and counterpunching the indicated positions or by referring to blueprints and locating the holes with a rule and divider. Secures parts temporarily with bolts or spring fasterners preparatory to riveting. May rivet plates and structural members together using huck rivet guns, huck lock bolt guns, yoke type huck guns and cherry rivet guns to perform operation within the capacity of the equipment. Makes minor changes as called for on engineering order requiring substitution or replacements of parts where major revisions in methods and procedure are not required. Installs gasoline and oil lines, instrument tubing, electrical conduit, hydraulic and pressure systems and other tubing and piping systems in airplanes under construction: Studies operations sheets, blueprints and other written manufacturing information to determine sequence of operations and methods of installation. Establishes the location of preformed tubing by use of jigs and fixtures where tolerances are easily maintained or lays out location, working from established reference points, guided by blueprints or verbal instructions. Installs brackets in predetermined locations by drilling holes with an electric power drill, bolting

to structure with wrench or inserting screws in holes and tightening them with screwdriver. May rivet brackets in place with pneumatic riveting hammer. Adjusts curvature of tubing to airplane structure by bending tubing by hand or with portable pipe-bending machine. Marks tubing with scriber at point where it is to be cut for connection with fittings or other tubing, cuts with hacksaw and flares end to facilitate connection. Tightens couplings and fittings with wrench, making sure that there is a proper seal at all unions. Makes change in tubing installations as called for by engineering orders, cutting, threading, bending and connecting pipe as required. Assists higher classification workers in making functional check of assigned plumbing and hydraulic systems to determine if installations have been in accordance with specifications and to discover any malfunctioning. Performs rework and makes necessary repairs, adjustments or replacements.

Puts together and installs partially assembled aircraft engines in predetermined location on airplanes under contruction: Lifts engine with power hoist into an engine-mount on a portable engine-mount stand. Installs such accessories as carburetors, generators, fuel and oil pumps, spark plugs and electrical equipment, guided by blueprints, diagrams, operations sheets and verbal instructions. Builds up engine nacelles by installing assemblies, wiring, tubing and accessories in predetermined locations, using operations sheet as a guide. Hoists engine and attached mount to its proper position in wing of plane and bolts mount to firewall of airplane. Connects fuel and oil lines, pressure gages, engine control rods and instrument lines on engine to their corresponding fittings on firewall by clamping, screwing, and attaching gaskets and installation as required, guided by blueprints, diagrams and other written instructions. Assists higher level workers in making functional check of the mechanical operations of power plant accessories to ascertain if functioning in accordance with specifications and makes necessary repairs, adjustments or replacements. Makes necessary changes in engine assembly or hook-up as called for in engineering orders.

Fits and installs control surfaces such as rudder, elevator, ailerons, and flaps and connects cabin controls to them by means of cables routed through wings and fuselage: Studies operations sheets, blueprints and other written manufacturing information to determine procedure and sequence of installation. Establishes the location, fits and installs control surfaces such as ailerons, rudders, elevators and flaps by drilling holes with an electric power drill and bolting, screwing, or riveting them to structural members. Lays cables through aircraft in conformance with predetermined routing, working from blueprints, operation sheets and verbal instructions. Installs pulleys, brackets and rigging accessories to easily established locations, making routine adjustments and alignments for clearance, fit and tension. Hooks up rigging by tying into cabin controls. Makes installation adjustment and alignment of cables and controls systems by setting throw, cable tension, stop adjustment and clearance to required specifications using tensiometer, machinist scales and protractor. Makes functional check of rigging and control equipment and systems to ascertain if installations have been made in accordance with specifications and performs rework where necessary. Makes changes in installations or hook-ups when so directed by engineering orders.

Effectiveness of Norms: Only 65% of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the S-76Rnorms, 91% would have been good workers. Thirty-five percent of the non-test-selected workers used for this study were poor workers; if the workers had been test-selected with the S-76Rnorms, only 9% would have been poor workers.

Applicability of S-76RNorms: The aptitude test battery is applicable to jobs which include a majority of duties described above.

GPO 898.709

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